Satoshi IMURA* & Kouji UNE*: **Endogenous gemmae in *Macromitrium gymnostomum* Sull. et Lesq. (Orthotrichaceae, Musci)****

伊村 智*・畦 浩二*: ヒメミノゴケ（タチヒダゴケ科・蘚類）の内生無性芽について

Ten species of *Macromitrium* have been reported from Japan (Noguchi 1967). Of these, only *M. reinwardtii* Schwaegr. is monoicous (autoicous); the other nine species are dioicous and produce dwarf males (Une 1985a). *M. gymnostomum* Sull. et Lesq. has been found in Japan (Honshu to Ryukyu), Korea, Taiwan and China (Noguchi 1967, Lai & Wang-Yang 1976). It is one of the commonest species of this genus in Japan (Une 1985b). The sexuality of this species was described as autoicous (Noguchi 1967), but Une (1984, 1985a) described the production of dwarf male and normal male plants in this species, and used new term "pseudonanandrous" (Use 1985a) for this type of sexuality.

Correns (1899) reported a deciduous leaf arista in *Macromitrium retusum* Wils. in Hook. as a vegetative reproductive structure. Sainsbury (1935) also reported similar vegetative reproductive structures in *M. retusum* and *M. gracile* (Hook.) Schwaegr. Recently, Vitt (1983) reported cylindrical gemmae on the leaf of *M. watsii* Broth. in New Zealand. Several species in other genera of Orthotrichaceae, such as *Zygodon*, *Orthotrichum* and *Hypnodontopsis*, are known to produce fusiform or cylindrical gemmae on stems or leaves (Iwatsuki 1957, Noguchi 1968, Saito 1970).

In this paper, we present the first report of endogenous gemmae of *Macromitrium gymnostomum* Sull. et Lesq., based on Japanese specimens.

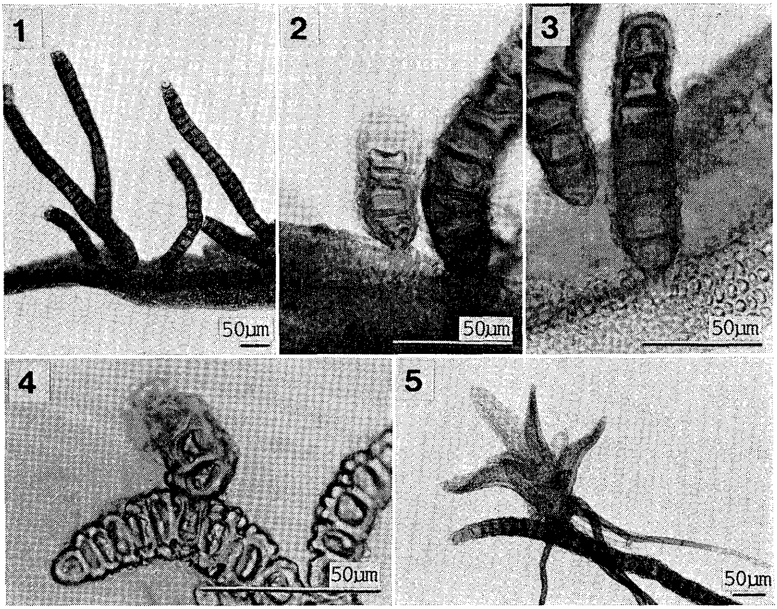
Observation The gemmae arose only on the leaves from the upper portion of a branch, and they are not found on the stem leaves. They are produced endogenously from laminal cells, mainly on ventral, or occasionally on dorsal surfaces (Figs. 1, 2, 3). The gemmae are cylindrical to filamentous, occasion-

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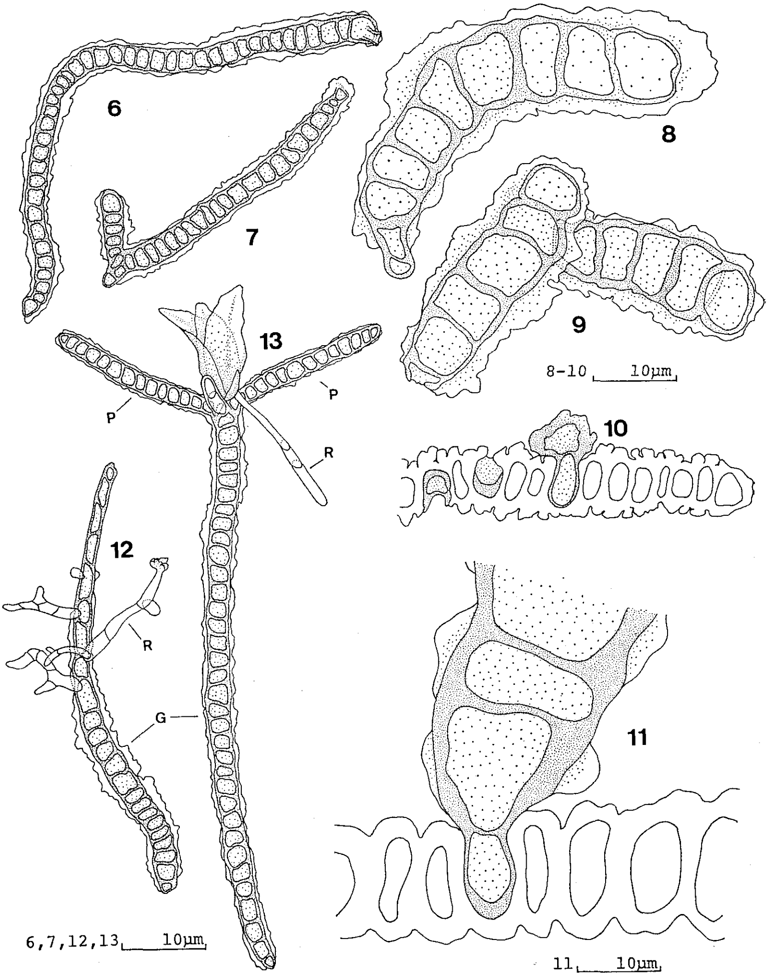
ally branched, 50–1000 μm long, 25–35 μm wide, with perpendicular septa, composed of 2–50 cells (Figs. 6, 7). Each cell is cylindrical, and contains chloroplasts when young. Cell walls are brownish, 2.5–4 μm thick, covered by irregular hyaline mucilage (Figs. 8, 9). An abscission-cell (tmema of Correns 1899) is not differentiated. Detachment may occur by the breaking of a basal cell of a gemma.

The gemmae are produced endogenously in cells of the lamina. The initial cell of gemma with a brownish wall is produced inside a laminal cell. This new cell grows to form a filamentous gemma before its liberation (Figs. 4, 10, 11).

Culture of gemmae Gemmae were sown on a filter paper which were saturated with distilled water in a Petri dish. The culture was grown at room temperature (ca. 20°C) and placed near the window under diffuse daylight. After about 10 days, almost all of the gemmae germinated, and produced extended protonemata, or occasionally rhizoidal filaments (Fig. 12). The protonemata were composed of somewhat slender, short cylindrical cells with



Figs. 1–5. *Macromitrium gymnostomum* Sull. et Lesq. 1, gemmae on leaf surface. 2, 3, gemmae from laminal cells. 4, portion of a cross-section of leaf, showing gemma formation. 5, bud on detached gemma. Figs. 1-4 from Deguchi 5536 (Herb. Kochi Univ.); 5 from Imura 1810 (HIRO).



Figs. 6-13. *Macromitrium gymnostomum* Sull. et Lesq. 6, 7, gemmae. 8, 9, gemmae (enlarged). 10, 11, cross-section of gemma initial cells. 12, germinating gemma. 13, germinating gemma and leafy bud. G, gemma; P, protonema; R, rhizoid. Figs. 6-12 were drawn from Deguchi 5536 (Herb. Kochi Univ.); 13, from Imura 1810 (HIRO).

thinner walls than the original gemmae. Mucilage surrounded the protonemata as well as gemmae, especially at the tip of the filaments. The cells of the protonemata were filled with chloroplasts, and look green, different from the

brownish gemmae. After about 30 days, gametophyte production was observed on almost all the germinating gemmae (Figs. 5, 13). Buds were formed on chloronemal filaments near the original gemmae.

Discussion In mosses, endogenous gemmae are known only in a few species. They are *Grimmia trichophylla* (Correns 1899), *G. torquata* (Correns 1899), *G. muehlenbeckii* (Correns 1899, Deguchi 1978), and *Rhacomitrium* sp. (Deguchi 1977). Also, in Hepaticae, endogenous gemmae are known in several genera, such as *Acromastigum, Aneura, Bazzania, Haplozia, Metzgeria* and *Perssoniella.* However, the developmental patterns of endogenous gemmae of these species are different from that of *Macromitrium gymnostomum.*

According to Une (1985a), the sexuality of *M. gymnostomum* is pseudo-nanandrous exhibiting both dwarf and normal males. Of the 159 specimens examined in this study, we observed female plants in 135 specimens, normal male plants in 23 specimens, dwarf males in 101 specimens, and the other 19 specimens were sterile. Of 159 specimens, gemmae were found in 29 specimens (18.1%). Gemmae were found more frequently on female (22 specimens) and sterile (7 specimens) plants, and very rarely on normal male plants (only one specimen). They were never found on dwarf males.

Of 29 specimens with gemmae, the majority (23 specimens) were collected in environments with high humidity, such as a valley bottom or stream side. Seasonal variation in gemmae production was not clear, but gemmae were observed mainly in the wet seasons of spring and autumn. Based on these observations, we think that gemma production in this species usually occurs under conditions of high humidity.

Selected specimens with gemmae: Nara-ken, Yoshino-gun, Ôtô-mura, Iridani valley, Deguchi 5536 in Herb. Kochi Univ. Wakayama-ken, Nishimuro-gun, Hikigawa-cho, Nakanogô-dani valley, Deguchi 9291 in Herb. Kochi Univ. Hiroshima-ken, Yamagata-gun, Tsutsuga-mura, Ryûzu-kyo gorge, Imura 1059 in HIRO; Saiki-gun, Miyajima-cho, Miyajima Isl., Une 5040 in HIRO.

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樹幹や岩上に比較的普通にみられるヒメミノゴケに，これまで知られていなかった無性芽を見いだした。無性芽は葉身上に形成され，2-50細胞からなる糸状で，細胞壁は厚く外側は粘液質に包まれている。本種の無性芽の大きな特徴は，無性芽の始源細胞が葉身細胞内に内生的に発生する点で，それが葉身細胞外に伸長して糸状の多細胞性無性芽となる。このような内生的発生をする無性芽は蘚苔類では非常に稀である。また，濾紙上で培養した結果，極めて高い発芽率と配偶体形成率を示した。本種は雌雄異株であり，雄には正常型のものと矮雄との二型がある。無性芽はおもに雌植物体上に形成され，正常型の雄には極めて稀に見い出されるが，矮雄には見られなかった。一方，無性芽をつけた標本はほとんどが渓谷や流れの近くで採集されたものであり，本種の無性芽形成は高い湿度条件下で起こると考えられる。

□松崎芳郎（編・著）：**年表・茶の世界史** 330pp. 1985. 八坂書房，東京. ¥6,800. 著者は大東文化大学卒業後，茶業組合中央会議所に勤務し，茶に関する出版物の収集・整理をしていた頃のメモをいかして年表を作った。第2部は茶の世界小史で，中国，日本，西欧諸国とまとめ，最後に二十世紀の動向を記す。参考文献，人名索引あり。

（木村陽二郎）